DOCUMENT RESUME

ED 175 490 JC 790 365

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TITLE A Multiple Regression Analysis of the Variables from the CGP Test upon GPA.
PUB DATE Jun 79
NOTE 27p.; Graduate Seminar Paper, Northeastern University

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Achievement Tests; Community Colleges; Females; *Grade Point Average; Junior Colleges; *Junior College Students; Males; Multiple Regression Analysis; Predictive Ability (Testing); *Predictive Measurement; *Predictor Variables; Reading Tests; Student Motivation; Student Placement; *Student Testing
IDENTIFIERS *Comparative Guidance and Placement Program

ABSTRACT

Prior to attending Mount Wachusett Community College, Massachusetts, all freshmen are required to undertake a Comparative Guidance and Placement (CGP) test which yields raw scores in reading, sentences, math, and academic motivation. Based on the scores on the continuous independent variables measured by the CGP test and the dichotomous independent variables of sex, level of math test selected by the student, and the type of program (career or transfer), a study was conducted to investigate the relationships, strengths, and significance of the variables in predicting student grade point average (GPA) after one semester's work. All of the variables from the CGP test were found to be significant at the 5% level; the order of importance of the variables in predicting GPA was sentences, academic motivation, reading, math, sex, and type of math test. With the data factored by program and sex, the regression analysis yielded no most important variable. Female students earned significantly higher GPA's than did their male counterparts. Career students, whether male or female, earned higher GPA's than did those enrolled in transfer curricula. A review of the literature and the raw data are included in the study report. (AYC)

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ADVANCED RESEARCH DESIGN IN EDUCATION
Northeastern University
Professor M. Lynch

A MULTIPLE REGRESSION ANALYSIS OF THE VARIABLES FROM THE CGP TEST UPON GPA

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by
Raymond Rogers
June, 1979

JC 790365

ABSTRACT

This research was conducted on data from the 483 freshmen who entered Mount Wachusett Community College in Gardner, Massachusetts, in the fall of 1978. All students were tested prior to attending classes through the Comparative Guidance and Placement (CGP) program. The CGP test yields scores for sentences, reading, math, and academic motivation along with the student's sex and level of math test the student selected to take.

All of the variables from the CGP test were found significant at a 5% level, giving validity to the CGP test as a predictor of a student's grade point average (GPA). The order of the importance of the variables in predicting GPA was sentence, academic motivation, reading math, sex, and type of math test. With the data factored by program (career or transfer) and sex, the regression analysis yielded no consistent most important variable; however, academic motivation was constantly the second most important variable in explaining a student's GPA.

Female students earned significantly higher GPA than did their male counterparts. Continuing evidence to the convention of promising female students being directed to the local, low cost, newer, open-door community college, while promising male offspring are directed towards the more traditional, selective, and expensive colleges. Also career students, whether female or male, earned a higher GPA than did students enrolled in transfer curricula. There exhibited more predictability, less deviance, in the GPA of students enrolled in the career programs. Realization of this being their last opportunity for schooling for the career student and an acknowledgment that GPA affects job placement.

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I. PURPOSE OF THE STUDY

The purpose of the research is to study the predictability and to understand student's grade point average (GPA) after one semester of college. Prior to attending classes, all freshman students are required to undertake a Comparative Guidance and Placement test (CGP) which the college obtains through the Educational Testing Service.

The test results yield raw scores in reading, sentence, math and academic motivation. Based upon the dichotomous independent variables of sex, level of math test selected by the student, and the type of program (curriculum), whether career or transfer, and the scores on the continuous independent variables of reading, sentences, math, and academic motivation, this study will investigate their relationships, strengths and significance in predicting student's grade point average after one semester's work.

II. THE PROBLEM

A. HISTORICAL BACKGROUND

There exist no system of tracking within the Massachusetts Community College System, as it operates on an open door policy. That is, students are accepted, having obtained a high school diploma or its equivalent, and enrolled into the program of their choice. However, in order to facilitate a student's program selection, an admission counselor will review, along with the student, his/her previous academic record and results of scores on the CGP test which are administered periodically throughout the spring and summer months prior to the start of the college year. Together the admission counselor and the student select courses best suited for the student's academic level.

Prior to 1973, student acceptance and placement into courses was based solely on the student's previous record and the admission counselor's experience. Since many of our students, over forty percent,[1] are entering college after having been out of school for more than a year, and with no standardized scores to compare a student's academic ability, as SAT's are not required, the admission procedures approached a random or hit and miss process.

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[1] Comparative Guidance and Placement Program, "MWCC Freshman Scores, 1974 - 1977." Educational Testing Service. pp. 14.

B. NEED FOR THE STUDY

The Massachusetts Community College System has a responsibility for providing an equal opportunity for all students to matriculate into courses and programs at the college of their choice and to complete the degree requirements.

> It is the goal of the Massachusetts Regional Community Colleges to provide residents of the Commonwealth with an optimum opportunity for access to a College education consistent with their interest and aptitudes and to reduce to a minimum the economic, social, psychological, and academic barriers to educational opprotunity. [2]

To fulfill this goal without a uniform or standardize admission procedure and data is unlikely. The CGP testing procedure yields standardize scores by which students can be evaluated, compared and placed into courses. However these raw scores have never been tested or examined for their validity in predicting student's success. That is, success as measured by the student's grade point average, which is a weighted score based on the grades earned in individual courses. No examination of the weight of the individual independent variables has been undertaken in order to better understand the student population being served. Thus the need for such a study.

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[2]Massachusetts Board of Regional Community College, "Admission to Massachusetts Regional Community College, Policy." November 12, 1976.

C. REVIEW OF LITERATURE

The crux of the problem is to investigate what affects student success - grades. Studies of the GPA (grade point average), of students over a four year period at Harper College, examined the changes in GPA to see if the changes, improvements and declines, were attributed to age, sex, and/or career vs. transfer courses. "The factor affecting GPA most was age, with students twenty-one and over earning half a grade point higher average than those students under twenty-one years of age. In addition, students enrolled in career courses earned about one-fifth of a grade point higher than those in baccalaureate-oriented courses."[3]

At Wilkes Community College a study was conducted to determine if the differences in grades could be attributed to whether or not the students were employed while attending school. Their data led to the conclusions that there was "no significant difference in GPA of full time employed students and the total student population."[4]

Utilizing the Chi Squared statistical technique, an analysis of academic achievement and attendance at Polk

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[3]Lucas, John A. "Longitudinal Study and Grade Point Performance of Students Entering Harper College." Research in Education. ERIC. ED 095 941 April 1974.

[4]Deal, Gloster, Parrott and Toss. "An Analysis of Current Grade Point Averages of Employed Full-Time Students at Wilkes Community College." Research in Education. ERIC. ED 097 939 December 1973.

Community College concluded that "overall end-of-course grades would be higher if regular attendance in classes were maintained by all levels of students."[5]

The use of a personality questionnaire was used at Essex County College in order to obtain an achievement motivation coefficient and to test its relationship to grades received in psychology. The results of the study showed that "there was no correlation between the test scores on the personality questionnaire and grades in psychology courses."[6]

Within the classroom, "academic potential as established by CGP scores; high, middle or low students can be successful in self-directed study." Also, "student achievement in English is unrelated to student attitude towards English."[7]

The utilization of the CGP as an indicator of student abilities has been found in other studies. Robert Carbone used CGP and AICPA statistics to conclude that the "characteristics of the local community college population were similar to the national population." He also found a "high correlation between the CGP scores and performance on the

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[5]Nelson, H.H. "An Analysis of Academic Achievement and Classroom Attendance at Polk Community College." Research in Education. ERIC. ED 095 979 June 1973.

[6]Coleman, Thomas. "AStudy of the Level of Academic Motivation and Its Relation to Student Grades in Psychology at Essex County College." Research in Education. ERIC. ED 099 059 July 1974.

[7]Brodrick, M.A. "Effects of Self-Directed Learning Practices on the English Achievement and Attidues of Community College Students in Iowa and Nebraska." Dissertation Abstracts Information. Xerox. September 1976 pp. 1258-A.

final examination." This yields a degree of validity for the CGP scores which is the pre-test utilized to ascertain the independent variables to regress upon the student's GPA. Carbone's study concluded a somewhat obvious fact that "high-reading -ability and high-quantitative-ability students out perform low-reading-ability and low-quantitative-ability students regardless of teaching methodology. No single technique appears to be best for all students. Pluralism in educational methods apparently is essential to deal effectively with the wide diversity of students."[8]

Thus is has been found that age, type of program, career or transfer, and attendance significantly affect a student's GPA. Also the validity of the CGP test scores has been found to correlate highly with final exam scores. However, no study has dealt with a sample as large as the entire freshman class of 483 and examined the continuous variables reading, sentence, math and academic motivation upon students' GPA.

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[8]Carbone, R.A. "An Evaluation of a Learning-Oriented System of Instruction Used in the Teaching of a Beginning College Course in Principles of Accounting at a Community College." Dissertation Abstracts Information. Xerox. August 1976. pp. 776-A.

III. STATEMENT OF THE PROBLEM

A. What is the predictability of a student's grade point average based upon the independent variables obtained via the CGP testing procedure?

B. Is there a significant difference in the grade point average of students due to the effects of the dichotomous variables sex, the student's program (career or transfer), and/or level of math test selected?

IV. COLLECTION, PRESENTATION AND ANALYSIS OF DATA

The population is the freshman who entered Mount Wachusett Community College, a rural two year comprehensive community college located in North Central Massachusetts, in the fall of 1978. Prior to attendance, all students are pre-tested through the CGP testing program which yields scores in reading, sentences, math, and academic motivation along with sex and type of math test selected. After one semester each student receives a grade for each course, ranging from A to F from which GPA is calculated and the program the student is enrolled in is displayed. The researcher encoded the data onto eighty column Hollerith cards and utilized the various subroutines available through the SPSS, Statistical Package for the Social Sciences, to obtain the statistics and tests for the data.

A. STATEMENT OF THE PROBLEM - a.

To test the relationship of the independent variables the NONPAR CORR, nonparametric correlation subroutine was utilized for it computes the Spearman correlation coefficients and does not depend upon a normal distribution. The results, FIGURE 1, are examined to determine the direction and strength of the relationships between the variables. It is

noticed that GPA correlates positively with sentence scores (.37), reading (.35), math (.30), and academic motivation (.24). It is essential to examine the correlation coefficients to determine if two of the independent variables have an intercorrelation coefficient greater than .8. If so, the concern is of multicollinearity, for the greater the intercorrelation of the independent variables, the less reliability of the relative importance indicated by the partial regression coefficients.[9] In scrutinizing this data the highest intercorrelation is between reading and sentence scores (.64), hence little concern for multicollinearity.

The stepwise multiple regression anlaysis was performed which enters independent variables in single steps from best to worse. Thus, it enters first into the regression equation the independent variable that explains the greatest amount of variance in the dependent variable, GPA, then the second, and so on.

Utilizing the four continuous variables of sentence, motivation, reading, and math scores, FIGURE 2 displays that the strength of the regression equation, MULTIPLE R, is .44 and that 19.6% of the variance in GPA can be explained by these four independent variables which are all significant.

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[9]Nie, Norman. SPSS, Second Edition, McGraw-Hill Book Company, N.Y., 1975. pp. 340.

The regression equation is as follwos:

$$GPA' = .014\ \text{Sentence} + .018\ \text{Motivation} + .017\ \text{Reading} + .011\ \text{Math} - .55$$

FIGURE 3, the Summary Table, presents the independent contribution of each independent variable, yielding the sentence score to be the variable making the greatest contribution to explaining the variance in GPA followed by the variable academic motivation, reading, then math. It is important to note that each of these four independent variables have a significant F statistic and the t statistic is also significant for each variable at a 5% level.

A stepwise multiple regression analysis including the dichotomous variables sex and type of math test selected was performed, FIGURE 4. These variables increased the strength of the predictability to .45 and the two dichotomous variables were the last two, fifth and sixth, variables entered into the regression equation. The the regression equation becomes:

$$GPA' = .012\ \text{Sentence} + .017\ \text{Motivation} + .017\ \text{Reading} + .016\ \text{Math} - .12\ \text{SEX}^{*} - .058\ \text{Math Type}^{*} - .50$$

note: *SEX 0 = female, 1 = male
*Math Type = 1, 2, or 3

FIGURE 5 is a summary sheet for the breakdown of the population and sample statistics and the regression equations for each category by program and sex, and will be discussed in the Summary and Conclusion Section.

B. STATEMENT OF THE PROBLEM - b.

To test the significance of the dichotomous variables the SPSS, ANOVA, analysis of variance, subroutine was utilized. FIGURE 6 exhibits the results indicating that there is no significant difference in the GPA due to the two-way interactions or the three-way interaction of program, sex, or type of math test selected. There is a significant difference due to the main effects of sex and type of math test selected, but not due to the student's program (career or transfer) at a 5% level. However, the student's program would be significant at an 8% level. Thus this is the reason for incorporating variables of sex and type of math test selected into the stepwise multiple regression analysis, FIGURE 4.

The MCA, multiple classification analysis, which allows one to estimate GPA by adjusting the grand mean of 2.52 either (+) upwards or (-) downwards by the variables of program, sex, or type of math test selected is presented as FIGURE 6. It is seen from FIGURE 6 that female students earn higher grades than do male students, and students in career programs better than students in transfer programs.

V. SUMMARY AND CONCLUSIONS

The purpose of this research is to explain and predict GPA after one semester, given the CGP test scores and data as to sex, level of math test selected, and curriculum. The regression equations incorporating these variables have been generated along with the appropriate statistics. These statistics have been categorized and tested for significance.

It is evident females earn a significantly higher GPA than do their male counterparts. A possible explanation is the indigenous characteristic of the rural, ethnic geographic region the college serves. For the convention of promising females being directed to the local, low cost, new, open door community college holds true, whereas the promising male offspring is directed towards the more traditional, selective and expensive colleges.

The relative strength of the MULTIPLE R statistic utilizing the four continuous variables of sentence, motivation, reading, and math scores attained a level of .44. By adding the dichotomous variables of sex and type of math test selected, it reached a level of .45. However, when categorized, the career students, whether male or female, exhibited a higher MULTIPLE R statistic of .50 and .51, respectively. Thus demonstrating less

deviance. This increase in the MULTIPLE R in GPA by sex with the career student verifies the realization that this is the last opportunity for schooling for the career student and an acknowlegment that GPA affects their job placement. Whereas, the transfer student feels he/she still has time at the senior college to improve their GPA. Also for those students who are undecided and continue to postpone the selecting of a career or definite major, they tend to avoid a career program and select a general transfer curriculum.

In every category and in the overall regression analysis of the data, the second variable entered into the equation, thus the second most important variable in explaining the variance of GPA, was academic motivation. This is consistent with other research, indicating one's desire, expressed or perceived need to do well, can and does overcome one's initial level of cognitive skills.

FIGURE I

Analysis of CGP Scores on GPA

File Rogers

SPEARMAN CORRELATION COEFFICIENTS

GPA	.346	GPA	.372	GPA	.298
N	483	N	483	N	483
READING SIG	.001	SENTENCE SIG	.001	MATH SIG	.001
GPA	.141	GPA	.236	READING	.479
N	483	N	483	N	483
MTYPE SIG	.001	MOTIVA SIG	.001	MATH SIG	.001
READING	.292	READING	-.018	READING	.640
N	483	N	483	N	483
MTYPE SIG	.001	MOTIVA SIG	.344	SENTENCE SIG	.001
SENTENCE	.475	SENTENCE	.284	SENTENCE	.145
N	483	N	483	N	483
MATH SIG	.001	MTYPE SIG	.001	MOTIVA SIG	.001
MATH	.578	MATH	.101	MTYPE	.150
N	483	N	483	N	483
MTYPE SIG	.001	MOTIVA SIG	.013	MOTIVA SIG	.001

FIGURE 2

Analysis of CGP Scores on GPA
File Rogers

Dependent Variable. GPA

Variable(s) entered on step number 4. Math

Multiple R	.44341
R Square	.19661
Adjusted R Square	.18989
Std Deviation	.73283

Variables in the Equation

Variable	3
Sentence	.13921374E-01
Motiva	.18434411E-01
Reading	.16609077E-01
Math	.11268156E-01
(Constant)	-.55828980

All Variables are in the Equation....

FIGURE 3

Analysis of CGP Scores on GPA
File Rogers

Dependent Variable. GPA

SUMMARY TABLE

STEP	VARIABLE ENTERED	MULTIPLE R *	R SQUARE	R SQUARE CHANGE	SIMPLE R	OVERALL F	SIGNIFICANCE
1	SENTENCE	.345	.119	.119	.345	65.27	0
2	MOTIVA	.396	.157	.038	.238	44.87	.000
3	READING	.430	.185	.028	.325	36.40	0
4	MATH	.443	.196	.010	.301	29.24	.000

* Strength of Relationship to GPA'

Partial Correlations - hierarchial decomposition
the independent contribution of each independent variable.

R^2	=	due to Sentence	+	due to Motiva	+	due to Reading	+	due to Math
19.661%	=	11.9%	+	3.8%	+	2.8%	+	1.1%

FIGURE 4

Analysis of CGP Scores on GPA

File Rogers

Dependent Variable. GPA

Variable(s) entered on step number 6. Mtype

Multiple R	.45199
R Square	.20429
Adjusted R Square	.19426
Std Deviation	.73085

Variables in the Equation

Variable	B
Sentence	.11976336E-01
Motiva	.17358422E-01
Reading	.17236474E-01
Math	.16058375E-01
Sex	-.12083239
Mtype	-.58834554E-01
(Constant)	-.50558806

FIGURE # 5

$GPA = .017\ \underset{3}{Read} + .018\ \underset{2}{Motiva} + .011\ \underset{4}{Math} + .014\ \underset{1}{Sent} - .56$

$R = .44$

$R^2 = .196$

Stepwise Order

PROGRAM **SEX**

$\overline{GPA} = 2.52$
$\sigma = .81$
$N = 483$

Career

$\overline{GPA} = 2.58$
$\sigma = .82$
$N = 272$

Female → $GPA' = .029\ Sent + .017\ Motiva + .019\ Read - .82$

$\overline{GPA} = 2.65$ $R = .51$
$\sigma = .82$ $R^2 = .26$
$N = 158$

Male → $GPA' = .037\ Math + .014\ Motiva + .008\ Sent + .005\ Read - .82$

$\overline{GPA} = 2.48$ $R = .50$
$\sigma = .81$ $R^2 = .25$
$N = 114$

Transfer

$\overline{GPA} = 2.45$
$\sigma = .79$
$N = 210$

Female → $GPA' = .025\ Math + .018\ Motiva + Motiva + .014\ Sent - .44$

$\overline{GPA} = 2.56$ $R = .45$
$\sigma = .83$ $R^2 = .20$
$N = 101$

Male → $GPA' = .038\ Read + .02\ Motiva + .008\ Sent - .136$

$\overline{GPA} = 2.34$ $R = .43$
$\sigma = .75$ $R^2 = .19$
$N = 109$

FILE ROGERS (CREATION DATE = 79/06/13.) ADV RES AND DESIGN PROF LYNC

* A N A L Y S I S O F V A R I A N C E *

GPA
BY PROGRAM
SEX
MTYPE

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF
MAIN EFFECTS	16.108	4	4.027	6.319	.001
PROGRAM	2.017	1	2.017	3.165	.076
SEX	4.318	1	4.318	6.777	.010✓ SIGN
MTYPE	9.772	2	4.886	7.668	.001✓ SIGN
2-WAY INTERACTIONS	2.018	5	.404	.633	.674
PROGRAM SEX	.218	1	.218	.342	.559
PROGRAM MTYPE	.336	2	.168	.264	.768
SEX MTYPE	1.446	2	.723	1.135	.322
3-WAY INTERACTIONS	1.385	2	.693	1.087	.338
PROGRAM SEX MTYPE	1.385	2	.693	1.087	.338
EXPLAINED	19.510	11	1.774	2.783	.002
RESIDUAL	299.495	470	.637		
TOTAL	319.006	481	.663		

483 CASES WERE PROCESSED.
1 CASES (.2 PCT) WERE MISSING.

FILE ROGERS (CREATION DATE = 79/06/13.) ADV RES AND DESIGN

********MULTIPLE CLASSIFICATION ANALYSIS********

BY GPA
PROGRAM
SEX
MTYPE

* *

GRAND MEAN = 2.53

VARIABLE + CATEGORY	N	UNADJUSTED DEV N	ETA	ADJUSTED FOR INDEPENDENTS DEV N	BETA
PROGRAM					
0 = CAREER	272	.06		.06	
1 = TRANSFER	210	-.07		-.07	
			.08		.08
SEX					
0 = FEMALE	259	.09		.10	
1 = MALE	223	-.11		-.12	
			.12		.14
MTYPE					
1	151	-.16		-.17	
2	140	-.02		-.04	
3	191	.14		.17	
			.16		.18
MULTIPLE R SQUARED					.050
MULTIPLE R					.225

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